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About TSSPDCL

The Southern Power Distribution Company of Telangana, abbreviated as, TSSPDCL is a state Electricity Distribution company owned by the government of Telangana for the five southern districts of Telangana.

The Southern Power Distribution Company of Telangana Ltd (TSSPDCL) was incorporated under the Companies Act, 1956 as a public limited company on 02.06-2014 with headquarters at Hyderabad to carryout electricity distribution business as part of the unbundling of erstwhile A.P.S.E.B.

TSSPDCL has a vast infrastructure facility in its operating area with 1,605 Nos. of 33/11 KV substations 3,102 Nos. of power transformers, 1,220 Nos. of 33 KV feeders 7,263 Nos. of 11 KV feeders and around 4,22,003 Nos. of distribution transformers of various capacities. In addition to these, solar power is also considered a priority in order to overcome the shortage of power in the state.

TSSPDCL encompasses an area of 15 districts districts viz., Mahabubnagar , Narayanpet, Nalgonda , Yadadri Bhuvanagiri , Suryapet , Siddipet , Medchal , Wanaparthy , Nagarkarnool , Jogulamba Gadwal , SangaReddy , Medak , Hyderabad , Vikarabad and Rangareddy Catering to the power requirements of 9.75 million consumers.

Abstract

A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. Between the generating station and consumer, electric power may flow through several substations at different voltage levels. A substation may include transformers to change voltage levels between high transmission voltages and lower distribution voltages, or at the interconnection of two different transmission voltages.

Substations may be owned and operated by an electrical utility, or may be owned by a large industrial or commercial customer. Generally substations are unattended, relying on SCADA for remote supervision and control.

The word substation comes from the days before the distribution system became a grid. As central generation stations became larger, smaller generating plants were converted to distribution stations, receiving their energy supply from a larger plant instead of using their own generators. The first substations were connected to only one power station, where the generators were housed, and were subsidiaries of that power station.

Substations may be described by their voltage class, their applications within the power system, the method used to insulate most connections, and by the style and materials of the structures used. These categories are not disjointed; for example, to solve a particular problem, a transmission substation may include significant distribution functions.

Chapter 1

1.1 Introduction To - 33/11 Kv Substation

A Substation of rating 33/11kV means, the substation has been designed to receive 5 MVA of power at 33 kV and it will distribute the same on 11 kv

A substation is an electrical system with high-voltage capacity and can be used to control the apparatus, generators, electrical circuits, etc. The Substations are mainly used to convert AC (alternating current) to DC (direct current).

The following equipment are installed in Electrical General Services Sub-station:

(a) Distribution Transformer

(b) Circuit breaker

(c) Lightning Arrester

(d) Air Break (AB) switches/ Isolator

(e) Insulator

(f) Bus-bar

(g) Capacitor Bank

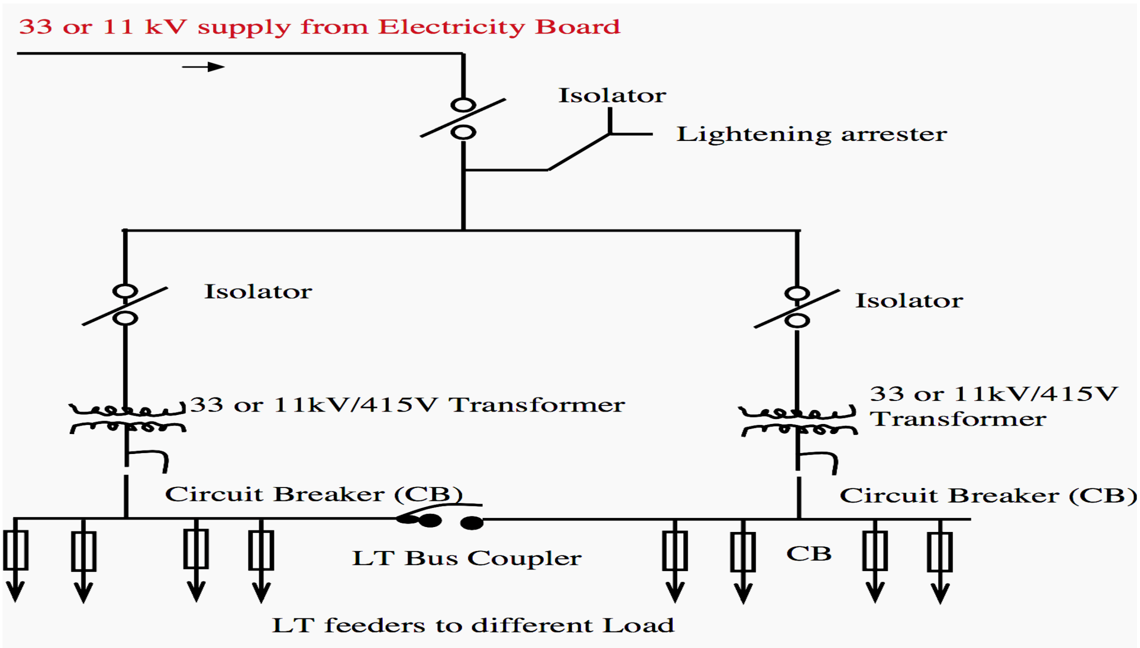
(h) Earthing

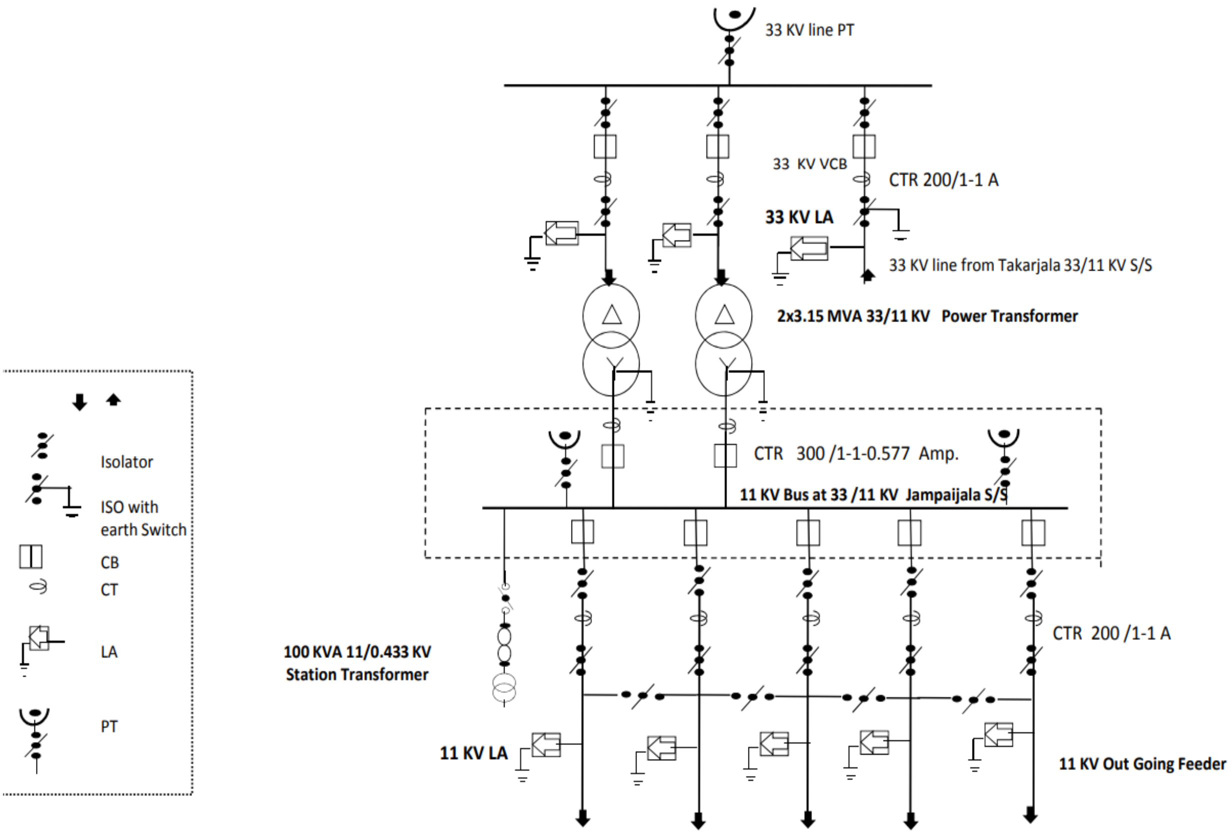
(i) Fencing

(j) Distribution panel board

Maintenance of a sub-station is essential to ensure un-interrupted electric supply to the using points which involves vigilance, care and well-defined scheme of procedures. Such scheme indicates the authority and responsibility of persons at various levels. It consists of many of periodic schedule maintenance, regular inspections, testing and rectification of defects.

1.2 Single Line Diagram Of 33 Or 11 Kv/440 V Substation:





1.3 Circuit Breaker(33Kv)

The circuit breaker is an equipment which automatically cut off power supply of the system when any fault or short circuit occurs in the system. It detect and isolate faults within a fraction of a second thereby minimizing the damage at the point where the fault has occurred. The circuit breakers are specially designed to interrupt the very high fault currents, which may be ten or more times the normal operating currents. There are many types of circuit breakers, e.g. Oil, minimum oil, Air blast, Vacuum, SF6, etc. being used at sub-stations. This list is generally in order of their development and increasing fault rupturing capacity, reliability and maintainability. In distribution substation, generally oil circuit breakers and air circuit breakers are used.

A circuit breaker is an electrical switch designed to protect an electrical circuit from damage caused by over current/overload or short circuit. Its basic function is to interrupt current flow after protective relays detect a fault.

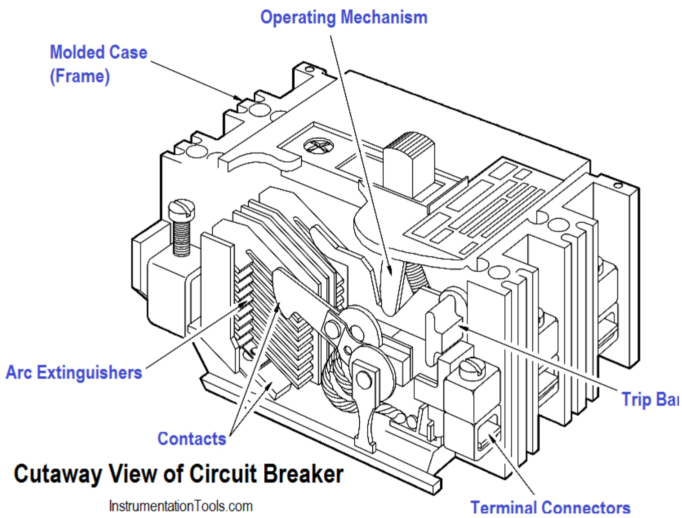
33kv VCB SAFVOLT offers a wide range of Vacuum Circuit Breaker, which delivers excellent performance. In order to prevent fires and power surges, these circuit breakers are used in areas where electric crisis may occur. These circuit breakers finds application in medium voltage power system.

No. of Poles	3
Rated Current	630-2500A
Voltage	33KV
Frequency	50/60Hz
Material	Porcelain
Phase	3

1.4 LV Breaker

A circuit breaker is an equipment which can open or close a circuit under all conditions viz. no load, full load and fault conditions. It is so designed that it can be operated manually (or by remote control) under normal conditions and automatically under fault conditions. For the latter operation, a relay circuit is used with a circuit breaker.

Rated current	125 A
Poles Number	4
Phase	Single Phase
Power Source	Electric
Frequency	50 Hz
Brand	ABB



Cutaway View of Circuit Breaker

1.5 Lightening Arrestors :

A lightning arrester is a device used on Electrical power systems from the damaging effects of Lightning. The typical lightning arrester has a high-voltage terminal and a ground terminal. When a lightning surge (or switching surge, which is very similar) travels along the power line to the arrester, the current from the surge is diverted through the arrestor, in most cases to earth. If protection fails or is absent, lightning that strikes the electrical system introduces thousands of kilovolts that may damage the distribution lines, and can also cause severe damage to transformers and other electrical devices. Lightning-produced extreme voltage spikes in incoming power lines can damage electrical appliances.

1.6 33KV-Bus

Usage/ Application	Industrial
Power	415-440VAC, 50HZ-60HZ
Resistance	Upto 50 kA
Type	IPC Connectors
Voltage Type	10 AMP TO 6500 AMP

1.7 Disc Insulators

An insulator that is made up of high-grade wet processes like brown-green glazed is known as disc insulator. These insulators are used in transmission & distribution systems. The designs of these insulators mainly change based on customer requirements. The properties of every electrical insulator include the following.

High resistivity

- Mechanical strength should be good for the conductor load.
- Dielectric strength is good
- For insulation material, its relative permittivity is high.
- It uses materials like non-porous or waterproof.

POST TYPE INSULATORS are commonly used in substations.

1.8 33 KV Potential Transformer

Up to 33KV, these are of electromagnetic type single and three phase voltage transformers. Above 33KV single phase outdoor potential transformers can be two types electromagnetic type and capacitive voltage transformer (CVT).

Features:

- Heavy insulating coating
- Durable finish standards
- Hassle free installation

The purpose of the Potential Transformer is to provide an isolated secondary voltage that is in-phase and exact proportionate representation of primary voltage.

Potential Transformers are used for both Protection and Metering purposes.

Potential Transformer-Name Plate Specifications:

1. Rated Primary Voltage: It is the rated continuous thermal limit voltage.
2. Rated Secondary Voltage: The rated secondary voltage usually 110/√3
3. Rated Burden: PT is rated by maximum burden (VA) at which it remains within specified limits of error.
4. Insulation Level: Combination of power frequency and impulse voltages at which PT can withstand.
5. Rated Voltage Factor: The multiplying factor to be applied to the rated primary voltage to determine the maximum voltage at which a transformer must comply with the relevant thermal requirements for a specified time and with relevant accuracy requirements.

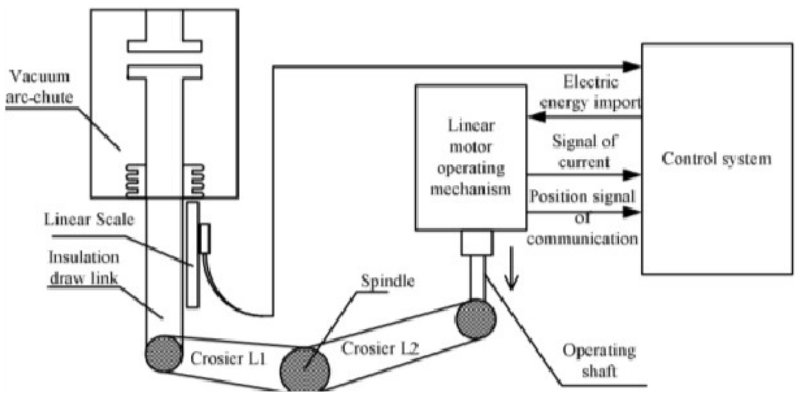
Chapter 2

2.1 Breaker Mechanism

Typically, the "closing spring" is mechanically charged by a motor and is held in its compressed position by a closing latch. When a close signal releases this latch, this spring pushes against a mechanical linkage to force the breaker contacts closed and, at once, charges the trip spring.

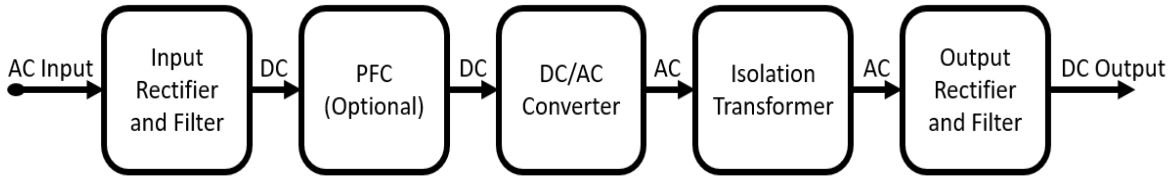
MECHANISM:

The operating mechanism creates and stores energy to operate the circuit breaker. It must always be able to trip the circuit breaker. Depending on the force required to operate the breaker, the circuit breaker may be equipped with one operating mechanism per phase or one mechanism for all three phases. The operating mechanism includes the energy storage medium, actuating circuit and interlocking systems.



2.2 AC And DC Supply In Transformer

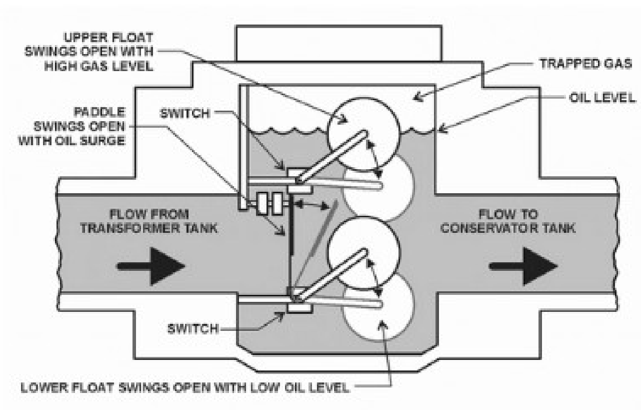
By using a transformer, the alternatin current (AC) input voltage is reduced to a value more suitable for the intended application. Then, the reduced AC voltage is rectified and turned into a direct current (DC) voltage, which is filtered in order to further improve the waveform quality .

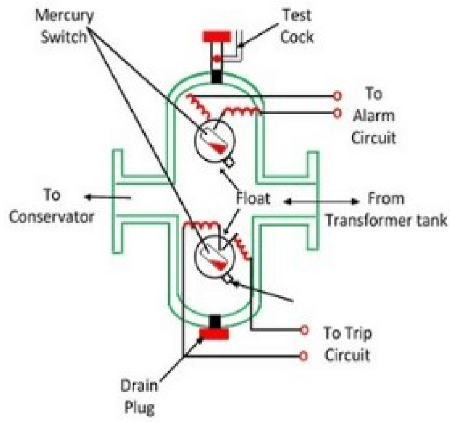


2.3 Buchholz Realy

The relay is connected to the oil piping between the overhead conservator tank and the main oil tank of a transformer. The piping between the main tank and conservator is arranged so that any gas evolved in the main tank tends to flow upward toward the conservator and gas detector relay.

In electric power distribution and transmission, a Buchholz relay is a safety device mounted on some oil-filled power transformers and reactors, equipped with an external overhead oil reservoir called a "conservator".





The Buchholz relay working principle is very simple. Buchholz relay function is based on a very simple mechanical phenomenon.It is mechanically actuated.

Whenever there will be a minor internal fault in the transformer such as an insulation fault between turns, break down of core of the transformer, core heating, the insulating transformer oil will be decomposed in different hydrocarbon gases, CO2 and CO.

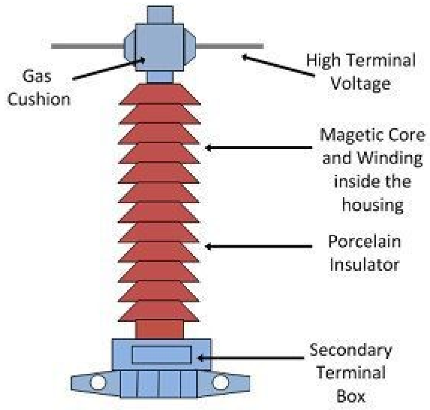
The gases produced due to the decomposition of transformer insulating oil will accumulate in the upper part of the Buchholz container which causes a fall of the oil level in it.

2.4 Current Transformer

The Current Transformer (C.T.), is a type of "instrument transformer" that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary. Current transformers reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual electrical current flowing in an AC transmission line using a standard ammeter.

Current Transformers produce an output in proportion to the current flowing through the primary winding as a result of a constant potential on the primary.

Current transformers are used for protection, measurement and control in high-voltage electrical substations and the electrical grid. Current transformers may be installed inside switchgear or in apparatus bushings, but very often free-standing outdoor current transformers are used.



CT is connected in series while PT is connected in parallel.

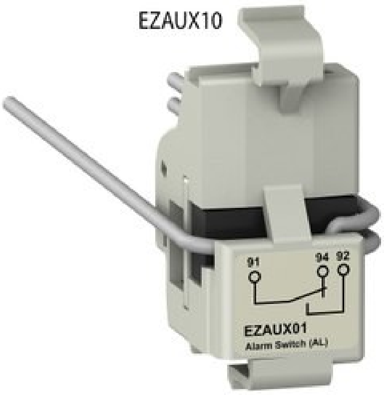
2.5 Interrupter

Vacuum interrupters can be used for circuit-breakers and load switches. Circuit-breaker vacuum interrupters are used primarily in the power sector in substation and power-generation facilities, and load-switching vacuum interrupters are used for power-grid end users.

An interrupter switch is a combination of an air disconnect switch and a circuit interrupter, which has a current interrupting rating, under specific circuit conditions, equal to or less than the continuous rating of the switch at rated voltage.

2.6 Auxilary Switch

An auxiliary switch is a single pole, double throw switch operated by the movable contact arm assembly. It is used to remotely indicate the position of the main circuit breaker contacts, whether open or closed.



Auxiliary Connection Terminal: Lead wire

Auxiliary Contacts Type: Standard

Brand: Schneider Electric

Conventional Free Air Thermal Current: 5 A

Device Application: Signalling

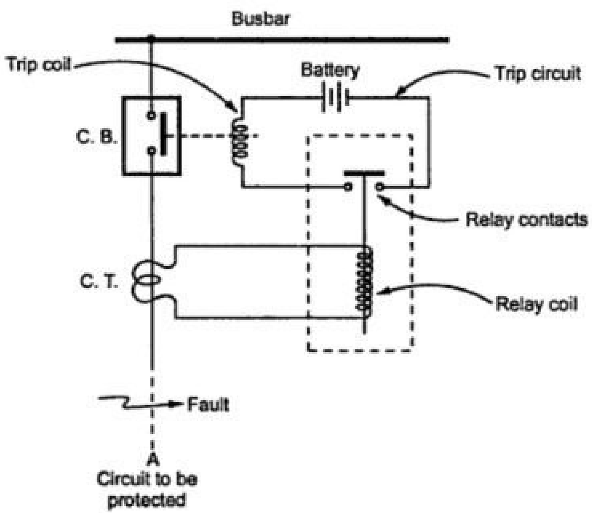
Device Short Name: AX

2.7 Closing Coil Of Circuit Breaker

The closing coil is an electrical accessory used for controlling the closing of the power contacts of the circuit breaker. The springs of the circuit breaker are to be loaded before the action of the closing coils. It is controlled by NO contact.

The close coil is triggered manually to reset the breaker and reconnect the circuit. Typically the close coil will be interlocked with various safety systems to not permit the breaker to reconnect if an abnormal or unsafe condition exists.

Circuit Breaker Closing Operation Requirement:



During closing operation of circuit breaker the followings are required,

The moving contact must travel towards fixed contact at sufficient speed to prevent pre-arcing phenomenon. As the contact gap reduces, arcing may start before contacts are closed finally.

During closing of contacts, the medium between contacts is replaced, hence sufficient mechanical power to be supplied during this circuit breaker operation to compress dielectric medium in the arcing chamber.

After hitting fixed contact, the moving contact may bounce back, due to repulsive force which is not at all desirable. Hence sufficient mechanical energy is to be supplied to overcome repulsive force due to closing operation on fault.

In spring-spring mechanism, generally tripping or opening spring is charged during closing operation. Hence sufficient mechanical energy also to be supplied to charge the opening spring.

2.8 Tripping Coil In Circuit Breaker:

Trip coils are the release components in circuit breakers used in energy distribution for the switching of high currents. It is their task to interrupt fault currents/voltages so that downstream systems are not damaged. The trip coil triggering solenoid initiates this separation mechanism.

The trip coil is triggered by excessive current flow through the breaker. When it energizes, it causes the breaker to open and interrupt the flow of current.

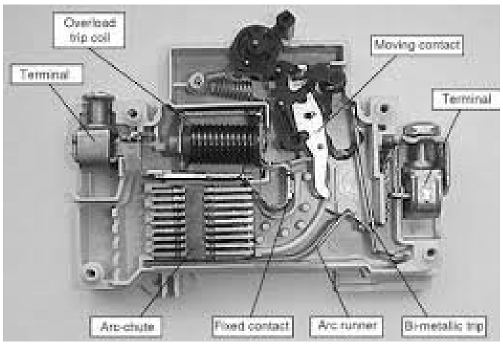
Trip coil is a solenoid coil which is connected to a sensitive circuit that designes to disconnect power line

Usage/Application: Ht Breaker

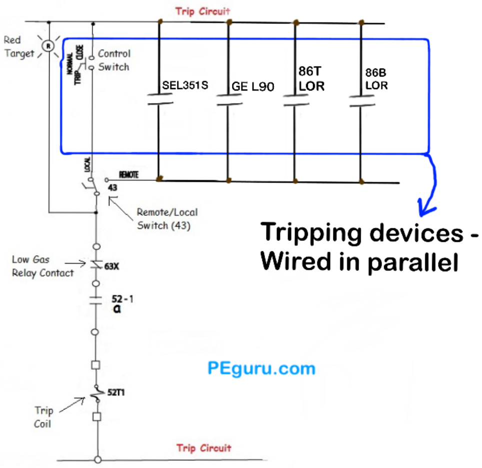
Voltage: 24-250 V DC/AC

Power: As Per Standard

Type: Plunger Type



Most modern circuit breakers are specified with two trip coils. Energizing either one trips the breaker. Since a good amount of redundancy is built into the protection and control of a power system, it is not uncommon to see all primary relaying in the system tripping trip coil 1 and the back-up tripping trip coil 2.



2.9 Limit Switch

A limit switch is a switch operated by the motion of a machine part or the presence of an object. A limit switch can be used for controlling machinery as part of a control system, as a safety interlock, or as a counter enumerating objects passing a point.[1]

Limit switches are used in a variety of applications and environments because of their ruggedness, ease of installation, and reliability of operation. They can determine the presence, passing, positioning, and end of travel of an object. They were first used to define the limit of travel of an object, hence the name "limit switch".

A limit switch with a roller-lever operator; this is installed on a gate on a canal lock, and indicates the position of a gate to a control system.

2.10 TNC Switch

TNC switch is a three position switch , when it is in. close position it put the circuit breaker in operation by. energizing the closing coil and when it is in trip position. it will trip the circuit by energising the trip coil in circuit. The switch return to neutral position after any operation.

It is a Three Position Switch, used for Closing or tripping the Breaker Manually from Control Panel/Relay Panel in the Control Room. The Three Positions are called as Trip, Neutral and Close. The Switch is always at the Neutral Position.

Working Principle:

TNC switch has 3 positions Trip, Neutral and Close. The neutral position is the default position of the switch. At the position, no DC pulse or command will go to the Trip or close coil. When it moves to the Trip position, the NO (Normally Open) contact which is used for the trip circuit will get NC and it will give the DC pulse to the Trip coil. When it moves to the close position, the NO (Normally Open) contact which is used for the close circuit will get NC and it will give the DC pulse to the close coil.

The spring is connected to the operating handle of the TNC switch to stay the switch at the Neutral position. In both the cases for tripping and closing, the operating handle of the TNC switch automatically gets back to the neutral position and NC contact becomes NO and breaks the DC supply for the coil.

Chapter 3

3.1 Distribution Transformer

A distribution transformer is a transformer that provides the final voltage transformation in the electric power distribution system, stepping down the voltage used in the distribution lines to the level used by the customer. The invention of a practical efficient transformer made AC power distribution feasible; a system using distribution transformers was demonstrated as early as 1882. Distribution transformers normally have ratings less than 500 kVA, although some national standards can describe up to 5000 kVA as distribution transformers. Since distribution transformers are energized for 24 hours a day (even when they don't carry any load), reducing iron losses has an important role in their design. As they usually don't operate at full load, they are designed to have maximum efficiency at lower loads. To have a better efficiency, voltage regulation in these transformers should be kept to a minimum. Hence they are designed to have small leakage reactance.

3.2 Voltage Transformer

It is essentially a step down transformer and steps down the voltage to a known ratio. The primary of this transformer consists of a large number of turns of fine wire connected across the line. The secondary winding consists of a few turns and provides for measuring instruments and relays a voltage which is a known fraction of the line voltage. Suppose a potential transformer rated at 66kV/110V is connected to a power line. If line voltage is 66kV, then voltage across the secondary will be 110 V.

Drop Out Fuse:

What are they In the utilities industry, a fuse cutout is a combination of a fuse and a switch. These units are used primarily on overhead feeder lines and are designed to protect distribution transformers from any current spikes or surges that can overload equipment.

A cutout consists of three major components:

a) Body: The frame which supports the fuse tub/blade and is mounted to the cross arm or bracket. The insulator body on this frame can be either polymer or porcelain material. The live connector parts are also mounted to the ends of this frame.

b) Fuse Holder: Known as the fuse tube or “door” that contains the fuse link. This piece acts as a simple switch. When the fuse operates, the fuse holder will drop open disengaging the switch from the line. This ensures any downstream circuits are electrically isolated.

c) Fuse Link: Also known as an element is the replaceable portion of the product that extinguishes due to higher than normal current transfers.

Working : A current surge from a customer circuit or a transformer will cause the fuse inside the tube to expand and melt. Once the fuse reaches maximum current capacity it breaks and this energy is thrown out of the bottom of the tube and disconnects the transformer from the line by the tube dropping out of the upper contact and swinging down on the hinge. The physical indication that the fuse has been extinguished and needs to be replaced is seen when the tube swings open and remains in a downward orientation.

3.3 Earth Mats:

The earth mats or grounding mats bring the connection to the earth indoors. They usually connect through a conductor inserted within the ground port of an electrical outlet. They help in limiting the ground potential & protect against the faulty current.

Grounded metal gratings placed on or above the soil surface, or wire mesh placed directly under the surface material, are common form of a ground mat.

Step 1: Soil Resistivity. ...

Step 2: Surface Layer Materials. ...

Step 3: Earthing Grid Resistance. ...

Step 4: Maximum Grid Current. ...

Step 5: Touch and Step Potential Criteria.

3.4 Earth Grid:

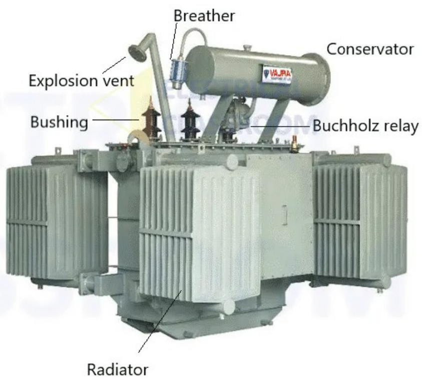
An earthing mat is a grounding system formed by a grid of conductors buried horizontally and provides a low impedance path for the earth's fault current to dissipate into the earth. The earthing grid present in the substation is an electrical connection to the earth at zero potential reference point.

An earthing grid is used as an electrical connection that is located to the earth at zero potential in which when a fault condition occurs then the flow of current dissipates into the ground through the low impedance path.

3.3 Power Transformer

Power transformers are electrical instruments used in transmitting electrical power from one circuit to another without changing the frequency. They operate by the principle of electromagnetic induction. They are used in transmitting electrical power between generators and distribution primary circuits.

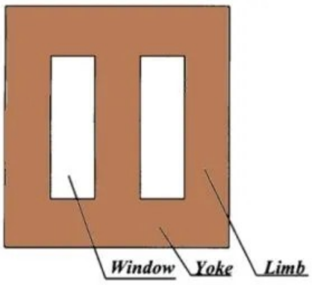
A transformer is made of several different parts that function in their own different ways to enhance the overall functioning of a transformer. These include core, windings, insulating materials, transformer oil, tap changer, conservator, breather, cooling tubes, Buchholz Relay and explosion vent.



3.4 Parts Of A Transformer:

CORE:

Core and Windings o Lifting the core and coils Remove the fixing devices if core and coils are suspended, from each end near the top. Unload the connections of bushings and remove the bushings from tank walls. Remove mechanical connection to the tap changing switch handle, if any. Remove any earthing strips between the core clamps and tank. Lift the core and coils vertically by slinging it from lifting lugs provided on core. Make sure that the sling does not foul against connections, tapping switch etc. Allow the core and coils to drain oil into tank for some time. Now lower them on beams placed in a metal tray filled with saw dust or sand.



INSULATING MATERIALS:

Insulation is the most important part of transformer. Insulation failures can cause the most severe damage to transformers. Insulation is required between the windings and the core, between windings, between each turn of the winding and between all current carrying parts and the tank. The insulators should have high dielectric strength, good mechanical properties and high temperature withstand ability. Synthetic materials, paper, cotton etc are used as insulation in transformers.

TRANSFORMER OIL:

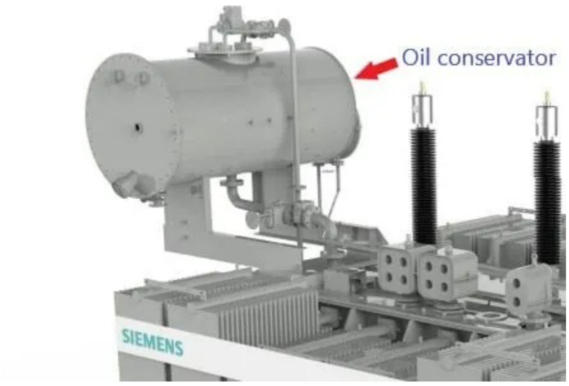
In all oil-immersed transformers, transformer oil provides added insulation between the conducting parts, better heat dissipation, and fault detection features. Hydro-carbon mineral oil is used as transformer oil. It is composed of aromatics, paraffin, naphthenes, and olefins. Transformer oil has a flashpoint of 310 degrees Celsius, relative permeability of 2.7, and a density of 0.96 kg/cm3

TAP CHANGER:

Tap changers are used to adjust the secondary voltage of transformers. They are designed to change the turns ratio of the transformer as required. There are two types of tap changers: On-load tap changers and Off-load tap changers.

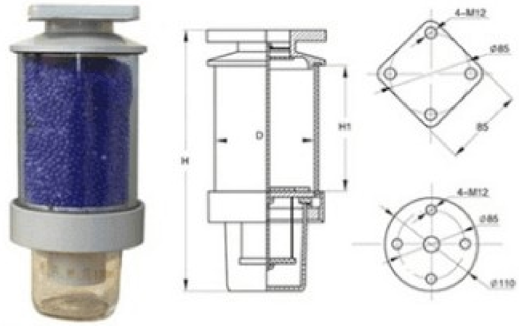
CONSERVATOR:

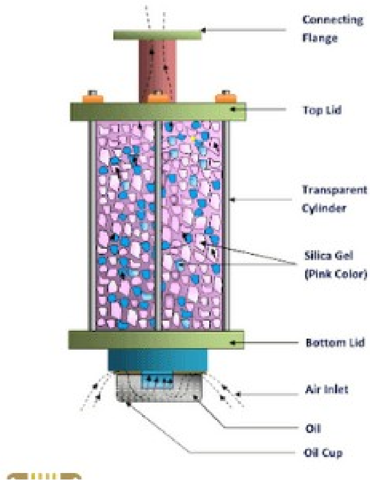
The oil conservator is moved on the top of the transformers and is located well above the tank and bushings. Normally a rubber bladder is present in some oil conservators. The transformer oil expands and contracts with an increase and decrease in temperature. The oil conservator provides adequate space for oil expansion. It is connected to the main tank through a pipe. A level indicator is fitted to the conservator to indicate the oil level inside.



BREATHER:

Breather is present in all oil-immersed transformers that have a conservator tank. It is necessary to keep the oil-free from moisture. As the temperature variations cause the transformer oil to expand and contact, air flows in and out of the conservator tank. This air should be free from moisture. Breather serves this purpose.





A breather is attached to the end of the air pipe such that the air enters and exits the conservator through it. The silica gel present in the breathers removes moisture from the air and delivers moisture-free air to the conservator.

RADIATORS AND FANS:

The power lost in the transformer is dissipated in the form of heat. Dry transformers are mostly natural air-cooled. But when it comes to oil-immersed transformers, a variety of cooling methods are followed. Depending on the kVA rating, power losses, and level of cooling requirements, radiators and cooling fans are mounted on the transformer tank.

The heat generated in the core and winding is passed to the surrounding transformer oil. This heat is dissipated at the radiator. In larger transformer forced cooling is achieved with the help of cooling fans fitted to the radiators.

BUCHHOLZ RELAY:

It is protective relay of transformer. This device signals the fault as soon as it occurs and cuts the transformer out of the circuit immediately. This is gas operated protective relay. It is installed in between the pipe connecting the tank and the conservator. This relay works on the formation of excessive oil vapors or gas inside the transformer tank due to internal fault of transformer. It consists of two operating floats A and B. These are operated by two mercury switches separately provided for each float. The float A is for bell alarm and float B is for operating the tripping circuit.

EXPLOSION VENT:

An explosion vent acts as an emergency exit for oil and air gases inside a transformer. It is a metallic pipe with a diaphragm at one end, held slightly above the conservator tank. Faults occurring under oil elevates the pressure inside the tank to dangerous levels. Under such circumstances, the diaphragm ruptures at a relatively low pressure to release the forces from within the transformer to the atmosphere.

Chapter 4

4.1 Maintenance and Inspection

MAINTENANCEThe schedule maintenance of equipment installed in sub-station is essential to ensure trouble free service and avoiding unnecessary interruptions.

Following safety precautions should be observed during maintenance of

transformers:

- Ensure all arrangements are safe.
- Isolate the transformer from supply and earth the terminals properly.
- Check & record the oil level in the tank before unseal the tank and unscrew the nuts .
- Ensure the work place is fire proof; care should be taken to prevent fire.
- Put a caution board “NO SMOKING”.
- The staff should not have anything in his breast pocket and should not wear watch or ring.

Item wise activities involved in various schedules of sub-station equipped with transformers up to 1000 kVA are as follows.

Inspection :

- Leads are not pulled out off their places.
- Ensure tightness of nuts and bolts.
- Clean the sludge by transformer oil and ensure that ducts are not blocked.
- Clamp the windings firmly without any movement. Adjust the vertical tie bars to tighten loose windings or spacers. Properly tight the special coil adjustment bolt, if provided.
- Check the proper operation of tap changing switch.
- Tight all connections.
- Conduct insulation resistance test and take the corrective action.
- Remove sludge deposition at the bottom of tank.

4.2 Schedules

DAILY SCHEDULE (If manned) :

Items		Schedule Inspection	Action required
Switch yard			
	All jumpers & other connections	Check visually for flash/ spark marks	Tighten the respective bi-metallic clamp/ connection
Transformer			
	Temperature	Check oil temperature during peak load hours. Check ambient temperature	Either switch off some load or share with other transformer
	Tank	Check for oil leakage	Arrest the leakage
	Dehydrating breather	Check visually colour of silica gel	Ensure blue colour of silica gel
Control Panel Room			
	Relays	Check visually target position	Take corrective action
	MCCB/Fuse		
	Load (amp.)	Check against rated figure	Reduce load if higher
	Voltage	Check against rated figure	Take corrective action
	PF meter	Monitor the PF reading	Take corrective action. It should be nearly unity
	General	Ensure general cleanliness of room and panels	
Capacitor Bank			
	All connections	Check visually for flash/ spark marks	Tighten the clamp/ connection

MONTHLY SCHEDULE: Note: In addition to daily maintenance, carry out following works:

Items		Schedule Inspection	Action required
Switch yard			
	Yard	Growth of unwanted shrubs, garbage etc.	Keep the yard free from shrubs, garbage etc.
	Earth pits	Check neatness and tidiness	Maintain tidiness and do watering
	Earth connections	Check all connection ends at earth pits and metal parts	Ensure solid connection
Transformer			
	Oil level	Check oil level in conservator	If low, top up with dry oil.
	Connections	Open terminal box cover and check connections visually for flash/spark marks	Take corrective action
	Dehydrating breather	Check air passages. Check colour of silica gel	Clear passages, if required. Reactivate silica gel if found pink
	Cleaning	Entire transformer body externally	Clean entire transformer externally including bushings
	Buchholz Relay	Check gas in the chamber	Take corrective action
Control Panel Room			
	Load (amp.)	Check load balancing	If found unbalance, distribute the load equally on all phases
	MCCB/Fuse	Check current ratings	Provide proper size of MCCB/ Fuse according to load condition

QUARTERLY SCHEDULE:

Note: In addition to monthly maintenance, carry out following works:

Items		Schedule Inspection	Action required
Switch yard			
	Support Insulators	Examine for cracks, rust and flash/ spark marks	Clean and replace if required
	Lightning arresters	Check line and earth connection	Clean and ensure rigid connection
	AB switch/ Isolator	Check for proper operation Check line and earth connection	Clean and lubricate Ensure rigid connection
	Jumpers	Check all jumpers	Tighten, if required
	HT bus bars	Examine bus-bar expansion joints etc.	Tighten, if required
Items		**Schedule Inspection**	**Action required**
Transformer			
	Bushing	Examine for cracks, rust and flash/ spark marks Check for oil seepage	Clean and replace if required Arrest leakage
Control Panel Room			
	Load (amp.)	Check load balancing	If found unbalance, distribute the load equally on all phases
	MCCB/Fuse	Check condition for overheating	Replace, if required
	LT Bus bars	Check visually for overheating, flash/ spark marks	Take corrective action

HALF YEARLY SCHEDULE:

Note: In addition to quarterly maintenance, carry out following works:

Items		Schedule Inspection	Action required
Transformer			
	Oil	Check BDV	If BDV < 30 kV/cm, do filtration to restore quality of oil.
	Cable box, gasketed joints and gauges	Inspect for leakage and cracks	Take corrective action
Control Panel Room			
	Load (amp.)	Check load balancing	If found unbalance, distribute the load equally on all three phases
	Oil circuit breakers	Check oil level in the tanks. Test the oil, if shows signs of moisture, carbonization or dirt. Check all valves for oil leakage. Check the condition of all gaskets provided to prevent entrance of water and leakage of oil.	Maintain at the proper height. Filter or replace if necessary. Arrest leakage Ensure they are healthy.
	ACB	Check entire unit	Clean with lint free cloth
		Check contacts	Clean fixed and moving contacts
		Operation Check tripping of relay	Clean and lubricate operating mechanism Re-set if required

YEARLY SCHEDULE:

Items		Schedule Inspection	Action required
Switch yard			
	Concreting/ coping of the supports	Check the condition of the concreting/ coping of the supports of the structures. The supports fixing to earth become weal and during the time of heavy rains, cyclone or flooding, the structure may fall, leading to a major breakdown.	If there are cracks or the coping of concreting is coming off, preventive action may be taken to concrete or coping.
	Gravel/crushed rock	Check leveling, oil stain and dust accumulation	Spray water to remove oil stain and accumulated dust. Maintain leveling to avoid formation of water pools.
	Earth resistance	Measure the earth resistance of individual equipment earth pit, preferably during summer	If it is beyond permissible limits, take corrective action
	Earth connection of metal parts	Check the earth connection of metal parts to ensure that the metal parts are properly connected to the earth so that any earth fault of the metal parts is cleared quickly and efficiently. If not, accidents may happen.	Take corrective action
	AB switches	Check operation.	Lubricate and ensure proper operation
		Check the line and earth connection of AB switches.	Ensure they are connected properly
	HT lightning arresters	Measure IR value Line-Earth	If low, replace it.
		Check the line and earth connection of HT lightning arresters	Ensure they are connected properly
	Connections from and to bus-bars	Check the connections	Tighten the connections properly from the bus bars and bars to the lines.
	Insulators	Clean and check all insulators for any crack or damage, flash/ spark marks.	Change, if cracks or damages are developing
Transformer			
	Winding	Measure IR value HV-Earth HV-LV LV-Earth	If low, investigate and take corrective action

Items		Schedule Inspection	Action required
	Oil	Check BDV	If BDV < 30 kV/cm, do filtration to restore quality of oil.
		Check for incipient faults	Perform dissolve gas analysis (DGA) as per annexure - B
	Buchholz relay, alarms and their circuits etc.	Check floats, alarm contacts, their operation, fuses etc. Check relay accuracy, etc.	Clean components and replace contacts and fuses if necessary. Change the setting, if necessary.
	Earth resistance	Check values of earth resistance	If high, investigate and take corrective action
	Body	Check for peelings/ rusting/ damage	Repaint, as required
	Cable box	Check the sealing arrangement for filling holes	Ensure sealing arrangement for filling holes

Chapter 5

5.1 Conclusion

Transmission and distribution stations exist at various scales throughout a power station. In general, they represent an interface between different levels or sections of the power system, with the capability to switch or reconfigure the connections among various transmission and distribution lines. The major station includes a control room from which operations are coordinated.

The central component of substation is the transformer, as it provides the effective in emphasebetween the high and low voltage parts of the system breakers serve as protectivedevice that open automatically in the event of a fault. Switches are controlled devices that can be opened or closed deliberately to establish or break a connection.

5.2 References

1) Handbook on Maintainance of Electrical general services substation

2) Maintainance substation of equipments – Elctrical Info

3) Substation Equipment – www.studyelectrical.com

4) “Substation Design and Equipments” by P.S Santnam P.V Gupta